Retaining Women in First Year CS Courses

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Abstract

General efforts to increase recruitment **and** retention of women students in information technology require frequent change in both organizational and educational practices. These same efforts seldom emphasize a change in both the faculty and students and most focus on changing specific behaviors – like programming practices. Through an integration of practices that have been shown to be individually effective, we have combined theory and research on individual and organizational change to help foster what we believe will be successful changes. This research describes the interventions employed at Norfolk State University during the 2005 – 2006 academic year to retain female computer science majors during and beyond their first year.

Problem

Over the past five years, Norfolk State University (NSU) has seen a decrease in the number of underrepresented students in the Computer Science Department. Attrition rates for first year students in CS courses are very high at NSU. This assessment is reflected in the graphs below which illustrate retention data for students enrolled in CS1 and CS2 courses.

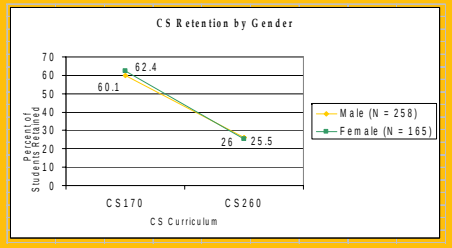

Chart 1. CS Retention by Race from 2000 - 2004

Research indicates that teaching styles strongly influence retention in science, mathematics, and engineering [2]. It also suggests that student will become active learners very early if they are involved in collaborative learning activities such as paired programming as freshmen. They learn to become active learners through goal-oriented problem solving in a laboratory setting [1].

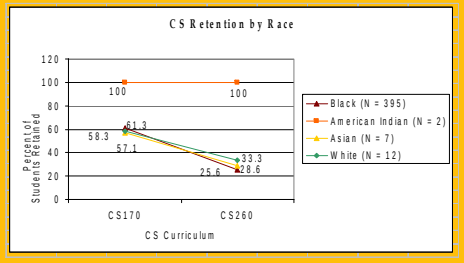

Chart 2. CS Retention by Gender from 2000 - 2004

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Approach

In our efforts to improve the retention of all CS majors, a more inclusive teaching style has been employed in freshman level computer science courses. We introduce new courses and focus on student attitudes, beliefs, and behaviors that are likely to improve socialization into the learning environment that exists in CS education and in the IT workplace.

Organizational changes include a structured training program for professors involved in the intervention and the incorporation of a new support organization for female majors. Curriculum changes have included the addition of CSC 101 (Introduction to the Computer Science Profession), closed laboratories in CS1 and CS2, and the use of collaborative learning and pair programming.

CSC 101 is designed to provide students with an accurate understanding of what a computer science professional does and how to succeed as a computer science major at Norfolk State University. The course introduces potential role models and provides lectures on topics such as:

- Role Models
- Active Coping
- Mentors/Mentoring
- Relationship Networking
- Collaborative Learning and Pair Programming
- Frequently Asked Questions about Computer Science

The new closed laboratories, modeled after those of "hard sciences," are two-hour professor taught sessions that run parallel to the CS1 and CS2 lectures. Pair programming has been incorporated into the CS1 and CS2 lectures and laboratories. An additional benefit of these curriculum changes is that students are acquiring soft skills including teamwork, interpersonal relationships, communication skills, and the ability to work with diverse groups of people.

First Year Results

Project interventions were implemented during the Fall 2005 semester. The data below represents retention rates from 2004 to 2006 after CS170 is completed and after CS 260 is completed. Chart 3 illustrates retention by gender, and when compared with Chart 1, you can see there is an increase in retention.

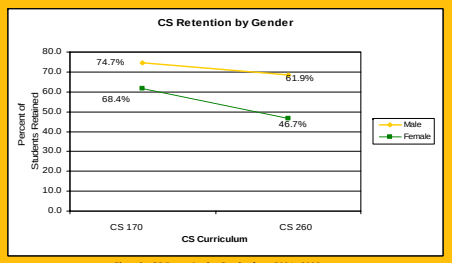


Chart 3. CS Retention by Gender from 2004 - 2006

Chart 4 depicts Retention by Race from 2004 to 2006. The percentage of American Indians retained over both semesters is equal to that retained during 2000 to 2004. The percentage of African Americans retained is much greater than those retained from 2000 to 2004.

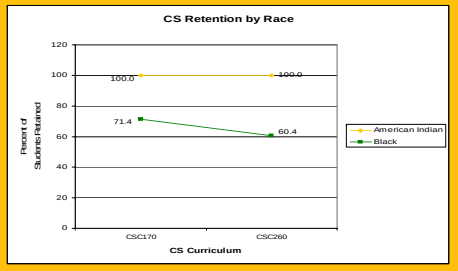
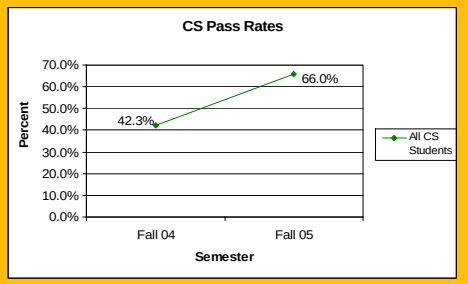


Chart 4. CS Retention by Gender from 2004 - 2006

First Year Results

The following chart illustrates the CS Pass Rates for all CS students from Fall 2004 to Spring 2006. In Fall 2004 the overall pass rate was a mere 42.3%. Although not stable, the rate has improved in subsequent semesters.



Conclusion

Norfolk State University (NSU) has implemented interventions to improve the retention of females and other underrepresented groups in the Computer Science Department. The interventions include new programming laboratory courses for CS1 and CS2, a new introductory course that considers student attitudes, beliefs, and behaviors that are likely to improve socialization into the CS learning environment and IT workplace, collaborative learning activities like pair programming, and special training for faculty on topics such as more inclusive learning styles.

Results from the first year are encouraging. Compared to baseline data, there was an increase in the retention of students who completed CS1 and CS2. Moreover, the percentage of African Americans retained in CS in the 2005-06 academic year was much greater than those retained from 2000 to 2004. There was also an increase in the retention of both males and females when compared to the data from 2000 to 2004.

Work on this project will continue during the 2006-07 academic year and additional data will be collected. We are pleased that faculty and students have embraced the interventions and that they appear to have had a positive impact on NSU's CS Department in general and student retention in particular.

Sources

[1] Parker, B.C. and McGregor, J.D, 1995. A Goal-Oriented Approach to Laboratory Development and Implementation, SIGCSE 1995 Nashville, TN, pg. 92-96.

[2] Seymour, E. and Hewitt, N. 1997. Talking about Leaving. Boulder, Colorado: Westview Press.